the described features or acts described herein. Rather, the described features and acts are disclosed as example forms of implementing the claims.

[0098] Those skilled in the art will appreciate that the invention may be practiced in network computing environments with many types of computer system configurations, including, personal computers, desktop computers, laptop/notebook computers, message processors, hand-held devices, multi-processor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, tablets, mobile telephones, PDAs, pagers, routers, switches, and the like. The invention may also be practiced in distributed system environments where local and remote computer systems, which are linked (either by hardwired data links, wireless data links, or by a combination of hardwired and wireless data links) through a network, both perform tasks. In a distributed system environment, program modules may be located in both local and remote memory storage devices.

[0099] In particular, one or more embodiments of the invention may be practiced with mobile consumer computing devices. Mobile consumer computing devices or more simply, mobile consumer devices, can be any of a broad range of computing devices designed or optimized for portability and for personal use. Mobile consumer devices can take a variety of forms, ranging from more traditional notebook and netbook computers to an emerging and rapidly growing market of handheld devices, including smart phones (e.g., the APPLE IPHONE, ANDROID phones, WINDOWS phones, SYMBIAN phones), tablet computers (e.g., the APPLE IPAD, ANDROID tablets), gaming devices (e.g., NINTENDO or PLAYSTATION portable gaming devices, the APPLE IPOD), multimedia devices (e.g., the APPLE IPOD), and combinations thereof. Many of these devices can enable rich user-interactivity by including combinations of output, input, and other sensory devices, such as touch- or pressure-sensitive displays (using capacitive or resistive technologies, for example), still and video cameras, Global Positioning System (GPS) receivers, magnetic compasses, gyroscopes, accelerometers, light sensors, proximity sensors, microphones, speakers, etc. These devices can also comprise a variety of communications devices, such as combinations of cellular modems (e.g., Global System for Mobile Communications (GSM), Code division multiple access (CDMA)), Wireless Fidelity (Wi-Fi) radios, Bluetooth radios, Near Field Communication (NFC) devices, etc. Many mobile consumer devices are expandable, such that a user can add new hardware and functionality not present during manufacture of the device. It will be appreciated that as the market for mobile consumer devices expands and develops, the functionality of these devices will also expand to utilize new and improved user-interaction devices and communications devices. The embodiments described herein are expansive and can also utilize any future developments in the field of mobile consumer devices.

EXAMPLE

[0100] The following Example describes an example of a test device that includes an iPhone and a test device coupled to the iPhone. The test device includes a slot for inserting a lateral flow assay cassette into the test device for reading and analysis by the iPhone.

[0101] There are a couple of challenges to imaging the measurement cassette. The first is to fill the iPhone's camera frame with as much of the detection strip as possible. This suggests a short distance between the camera and cassette. The second challenge is to evenly illuminate the detection strip to make image processing easier. This requirement suggests a longer distance.

[0102] Generally, even illumination is the more challenging requirement. In one embodiment, a light pipe or a similar device may be interposed between the illumination source (e.g., the iPhone's flash or another light source that is included in the test device). Light pipes are commercially available in various configurations, such as, but not limited to, cylinders and rectangles. The rectangle shape has been tested and been found to work better than the cylindrical configuration. The physical dimensions of the rectangular light pipe are in the following document online http://www.lumex.com/specs/LPB-R0112051S.pdf, the entirety of which is incorporated herein by reference.

[0103] As described above with respect to the Figures, the test device may include an accessory lens that is disposed between the camera's lens and the lateral flow assay cassette. The lens currently being tested has a 20 mm focal length and 6 mm diameter. This lens was ordered from Thorlabs.com with physical dimensions selectable in several formats from: http://www.thorlabs.us/thorProduct.cfm?partNumber=LA1700-A, the PDF version is: http://www.thorlabs.us/Thorcat/4400/4414-E0W.pdf, the entireties of which are incorporated herein by reference. A 30 mm focal length should be a good value for filling the iPhone camera's frame and achieving even illumination of the detection strip. A focal length of 60 mm is also an interesting choice since the iPhone may not need a second lens. However, this may potentially limit sensitivity in the final measurement.

[0104] One will of course appreciate that either the light pipe or the lens may include one or more light filters that allow selective illumination of the detection strip and/or detection of selection wavelengths of light from the detections strip. Likewise, the test device may include one or more light sources that emit selected wavelengths of for illumination of the detection strip. Analysis of images or a detection strip configured for detection of TSH with colloidal gold with a properly configured light pipe show dips in reflectivity in all three color channels (red, blue, green). With a proper exposure, there is a greatest difference in the green channel, corresponding to the 580 nm peak in the reflectance spectrum. The green channel shows a difference for both controls and the measured sample. This suggests that it may be best to illuminate with a selected wavelength of light that gives the best signal-to-noise ratio for detection of signal from colloidal gold when observing in the vicinity of 580 nm.

[0105] In this Example, there are two large changes relative to the device shown and discussed with respect to the Figures. Both of these changes relate to the orientation of the cassette. In this version the cassette is flat relative to the iPhone body and the long axis of the cassette being aligned with the long axis of the iPhone body. The image sensor in the iPhone is asymmetrical with the long axis of the image sensor being aligned with the long axis of the phone body. Orienting the long axis of the detection strip with the long axis of the phone orients the detection strip with the axis of the image sensor that contains the most pixels. The distance between the camera body and the cassette should be the focal length of the lens, in the present configuration 30 mm.

[0106] The center of the measurement part of the cassette where the sample should be on axis with the center of the